which are more of academic than practical importance. Bronchial stenosis has been only briefly referred to in connection with what has been said on lung syphilis. A more detailed consideration of it would not be practicable here, without taking up the subjects of bronchiectasis, diseases of the bronchial glands, emphysema, mediastinal tumors, and other pathological conditions which stand in intimate relation to it, either in the role of cause or effect. This subject alone could well afford material for a future discourse.

Pulmonary fibrosis coming on as a sequel of pneumonia, or following bronchiectasis, or appearing as the result of the inhalation of irritating substances or dust, the so-called "knife-grinders' phthisis," or anthracosis has been omitted because of the fact that the repeated finding of tubercle bacilli in the sputum of these patients leaves little doubt that they are mainly of tuberculous origin. What has been presented will, I believe, illustrate some of the difficulties which beset the diagnostician in his effort to accurately differentiate some of these perplexing lung conditions.

In conclusion I desire to emphasize the importance of a more thorough correlation of clinical and laboratory investigation. After painstaking physical examination has been made and the results interpreted in the light derived from careful consideration of the history and symptomatology; after conservative estimation of tuberculin reactions and with a true appreciation of their limitations; after radiography has been utilized and its sources of error obviated by more careful preparation and interpretation of *x*-ray plates; even then in many of these perplexing condition, the rock on which the diagnostician must stand will be the exact knowledge attained by modern laboratory methods.

X-RAY STUDIES OF SEROFIBRINOUS PLEURITIS.[1]

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Collections of fluid in the pleura, on account of their dense *x*-ray shadow, lend themselves especially to Röntgenological investigations. These *x*-ray studies have developed many new facts which are at variance with the accepted laws and theories governing the physical properties of pleural fluids; the most notable of these investigations relate to the inflammatory effusions, both of the costal and visceral pleuræ. The object of this paper is to emphasize the many new points made clear by diagnostic methods which have elucidated the true anatomicopathological properties of these exudates in contradistinction to what has been hitherto wrongly accepted under the form of classical descriptions of these conditions. The salient points which will be given most consideration concern the interpretation of the physical conditions produced by these effusions,[2] an accurate understanding of which will be of aid to both the clinician and the Röntgenologist.

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[1] Read before the Meeting of Röntgenologists of the Middle West, Chicago, April 8, 1911.

COSTAL OR PARIETAL PLEURISY.

The classic picture of this variety of pleurisy with effusion which dominates the text-books and literature is that of a mobile collection of fluid in the inferior portion of the upright chest, producing a dislocation of contiguous organs (Figs. 1 and 2). The well-known physical findings of mobile dulness in the lower part of the chest (patient in the upright position) not transmitting voice, breath, or whispered sounds, depending in extent upon the amount

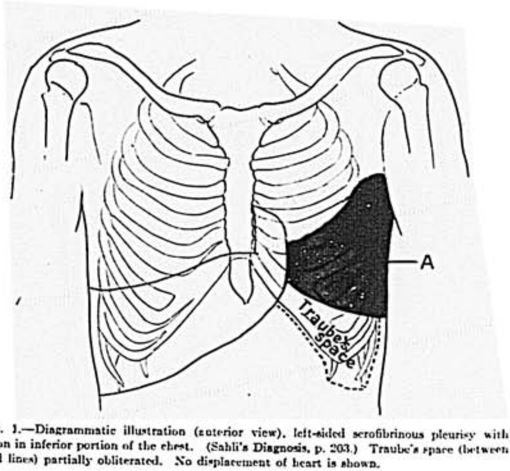

FIG. 1.—Diagrammatic illustration (anterior view), left-sided serofibrinous pleurisy with effusion in inferior portion of the chest. (Sahli's Diagnosis, p. 203.) Traube's space (between dotted lines) partially obliterated. No displacement of heart is shown.

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[2] Only those cases which could be classified under simple serofibrinous pleurisy, *i. e.*, having a serous effusion by cytodiagnosis, have been used as the basis of this article. No attempt has been made to classify the cases with regard to etiology or duration.

of the effusion, having an Ellis' or Garland's S-shaped line along the lateral boundary of the chest, and Skoda's phenomenon bordering the dulness above, has been so firmly ingrafted upon the medical mind, as to be the anticipated finding in every case of pleurisy with effusion. Many texts still contain diagrammatic illustrations, demonstrating how the pleural effusion, having these characters in the upright position, gravitates to the median or lateral side of the pleural cavity, in response to changes in the position of the patient. These classic descriptions have been based upon the supposition that all pleurisies are in the lower portion of the upright chest, and that the fluid is more or less mobile.

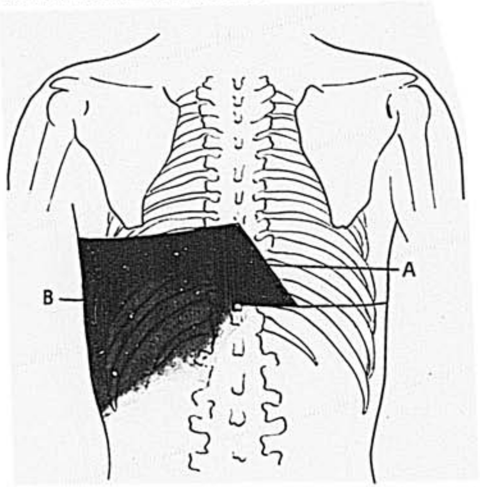

Fig. 2.—Same as Fig. 1, posterior view, showing *A*, Grocco's triangle, opposite the effusion (*B*).

That this is the exception rather than the rule, we have attempted to prove by giving illustrations of cases describing the common anatomical and pathological conditions existing in this disease. There have also been a number of other physical findings which have never been satisfactorily explained upon the basis that these effusions *always* occupy the lower portion of the upright chest. Among these are the following: (1) The presence of tympany over Traube's space with a left-sided pleurisy; (2) the presence of physical findings of fluid posteriorly and not anteriorly or vice versa; (3) the contention regarding Ellis' or Garland's S-shaped line; (4) the absence of displacement of organs with apparently large effusions; (5) the absence of Grocco's sign in some cases of pleurisy with effusion; (6) the variation in the degree of dulness in apparently similar collections, etc. An attempt at explanation of these and other confusing findings induced the authors to make a combined clinical and skiagraphic investigation of 50 cases of simple serofibrinous pleurisy, upon which the conclusions of this article are based. In these cases the physical findings have been compared with fluoroscopic and skiagraphic examinations, and, with the exception of 8 cases, controlled by aspiration of the chest and cytodiag-

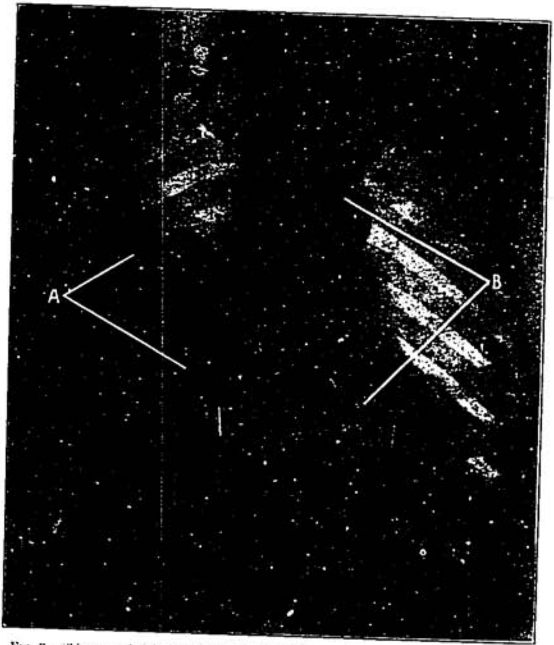

FIG. 3.—Skiagram of right-sided pleurisy with effusion, with patient in horizontal position: *A*, serous exudate. Note the upper line of the fluid is high toward the lateral side, but remains in the lower part of the chest in this (dorsal) position; *B* heart and vessel shadow.

variable positions in the chest. The fluid does not, as a rule, collect in the lower portion of the upright chest; this occurred in only 25 per cent. of our cases, as demonstrated both by physical and *x*-ray examination (Fig. 3). In the remaining 75 per cent. the location of the effusion occupied extremely variable positions in the pleura. In almost 25 per cent. of the cases, the fluid was in a vertical column in the lateral portion of the chest, compressing the whole lung toward the mediastinum (Figs. 4 *A*, *B*, and 5). In 34 per cent. of the cases the fluid was in a vertical position, enveloping the lateral aspect of the lung and extending nearer the median line posteriorly than anteriorly (Figs. 6 *A*, *B*, and 7). These effusions are best appreciated by studying stereoscopic skigraphs of the case. In about 16 per cent. of the cases a fluid occupied more or less of an upright position producing an oblique line across the chest, extending from above downward and inward (6 per cent.) or in the posterior portion of chest (9 per cent.) (Fig. 8), depending upon the size of the effusion. The smallest amount of exudate occupied the costophrenic angle of the pleura with the marked concavity of the shadow inward and upward. These Röntgenologic findings support the theory that the location of the fluid depends upon the position

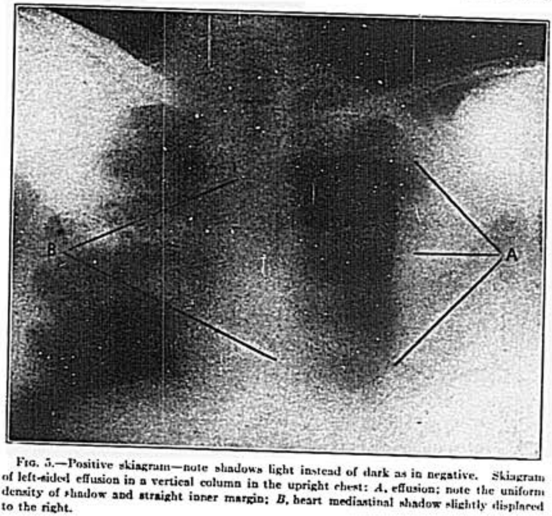

FIG. 5.—Positive skiagram—note shadows light instead of dark as in negative. Skiagram of left-sided effusion in a vertical column in the upright chest: *A*, effusion; note the uniform density of shadow and straight inner margin; *B*, heart mediastinal shadow slightly displaced to the right.

assumed most constantly by the patient during the acute inflammatory stage of the disease. For instance, if the patient is constantly upon his back, during this stage, he may have a collection of fluid limited to the posterior portion of the pleural cavity; if he is in the lateral position, the effusion may be confined to the lateral part of the chest; and if in the upright position, to the lower portion of the chest, etc.

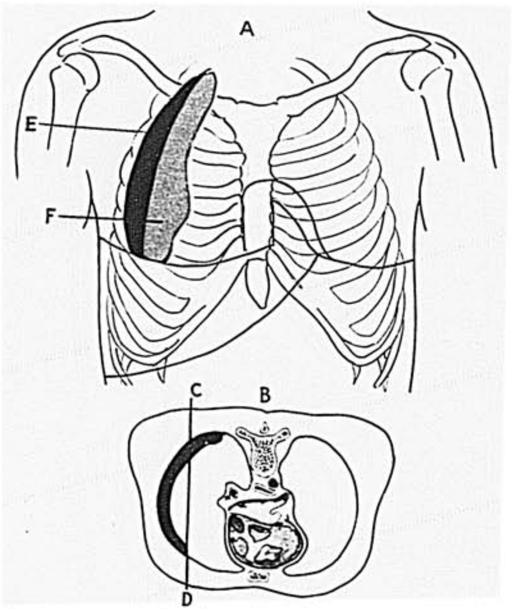

Fig. 6.—*A*, diagrammatic illustration of right-sided pleurisy with effusion, vertical column of fluid enveloping the lateral aspect of the lung, extending near the median line posteriorly than anteriorly; *B*, cross-section of the above; *C*, *D*, line projected through chest, showing how the *x*-rays external to this line passed through two thicknesses of fluid and those internal to the same passed through one thickness of fluid, explaining the differences in density of the shadows on each side of this line in Fig. 7.

Mobility of the Effusion. Contrary to the usual teaching, the effusion in pleurisy does not have the hydrostatic properties of fluid within a free non-encapsulated space. Fluoroscopic and skiagraphic examination of the above cases confirmed the work of others who have demonstrated by physical findings that these pleural exudates are slightly, if at all, mobile. Many of the exudates occupying the lower half of the upright chest (Fig. 3) remained in this position when the patient was turned in the lateral or dorsal position for Röntgenological examination. In all of the cases in which the fluid occupied a vertical position in the pleura of the upright chest (Figs. 5 and 7) the shadow was absolutely

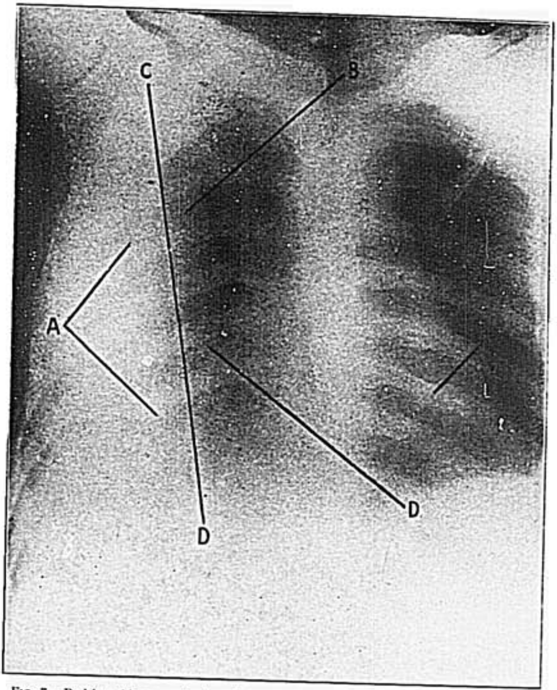

FIG. 7.—Positive skiagram—shadows light instead of dark as in negative. Skiagram of right-sided pleurisy with effusion. Vertical position of fluid enveloping the lateral aspect of the lung extending nearer the median line posteriorly than anteriorly: *A*, shadow produced by two thicknesses of fluid; *B*, posterior shadow produced one thickness of fluid posteriorly: *C*, *D*, line described in Fig. 6; *E*, heart shadow.

unchanged when the patient was placed in the lateral or dorsal position during x-ray examination. This was also true of those cases in which the fluid shadow occupied a more or less oblique position in the chest. These locations of more or less immobilized exudates can only be explained by the formation of adhesions encapsulating the fluid within certain definite limits. This is an important diagnostic fact, as it helps to differentiate the kind of fluid present withi the pleura. For example, nearly all other fluids except purulent hemorrhagic, etc., are freely mobile. The fluid, either transudat or exudate, having the greatest mobility is that associated wit free air in the pleural cavity. A pneumohydrothorax is the mos classic example of this variety. Next in order of mobility to pneumohydrothorax is the transudate of a hydrothorax. Th

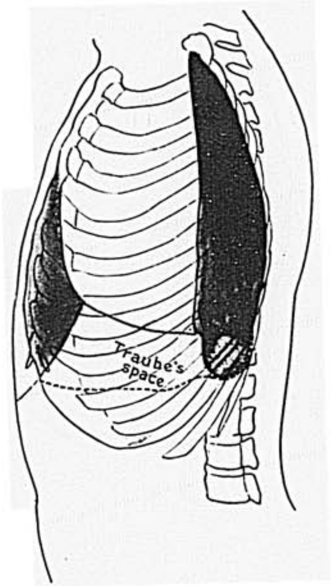

Fig. 8.—Diagrammatic illustration (lateral view) of a left-sided pleurisy with effusion, havin a vertical column of exudate located in the posterior portion of the upright chest. Note the absence of encroachment upon Traube's space and the other contiguous organs with the exceptio of the spleen, which is displaced downward.

fluid of a chylothorax (Figs. 9 and 10) is slightly less mobile than that of a hydrothorax, due probably to the character of the fluid and not to the condition of the pleura. The chyle, containing a larger amount of fat, has a greater viscosity than the serous exudate of a hydrothorax. In those pleurisies from which the fluid has been partially withdrawn (Fig. 11), the exudate becomes hydrostatic within its limiting capsule. For instance, in a number of the above

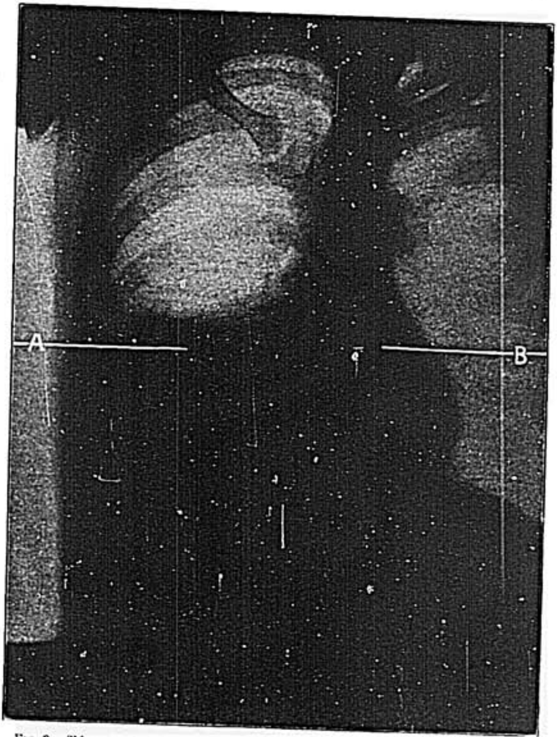

Fig. 9.—Skiagram of chylothorax. (Courtesy of Dr. L. Sale.) Patient in upright position: *A*, fluid shadow (note the upper line, which is nearly horizontal); *B*, heart and vessel shadow.

cases after a portion of the effusion was aspirated, the remaining fluid in the pleura was mobile within the limits of the fluid shadow cast before paracentesis. In none of the cases after partial withdrawal did a change of position of the patient affect the lung shadow.

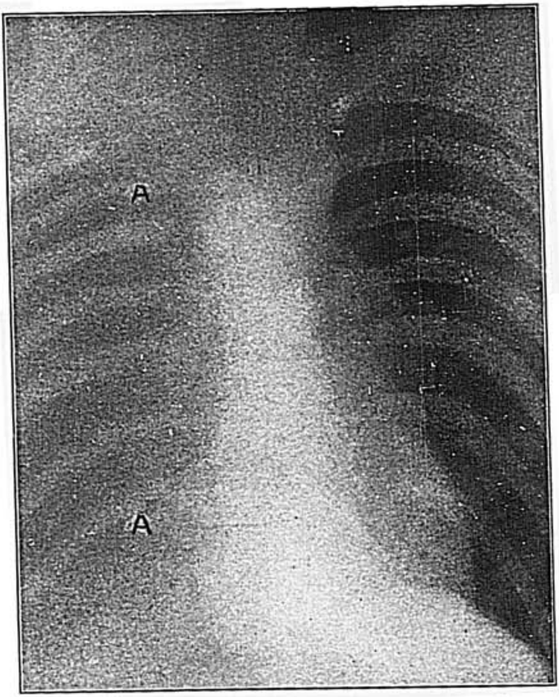

Fig. 10.—Positive skiagram—shadows light instead of dark as in negative. (Courtesy of Dr. L. Sale.) Patient in the horizontal position. Note that the effusion fills the entire right half of the chest, *A*, *A*, and that it is less dense than in Fig. 9, owing to the decreased thickness of the same, due to changed position. These two figures, 9 and 10, illustrate the mobility of the fluid with changed positions of the patient.

Displacement of Organs. A study of the location and mobility of the effusions as has been described above, will explain why all pleurisies with effusions do not cause displacement of organs. This does take place in those cases in which there is a large exudate in the lower half of the chest, but it is absent in the other cases. This can be seen from a study of the illustrations (Figs. 5, 7, and 8), which demonstrate an absence of marked displacement of the mediastinum, heart, diaphragm, and other organs. *X*-ray examinations have also demonstrated that in large effusions filling one-half of the chest, there is more displacement of the mediastinum at the centre than at its upper or lower portion. This fact com-

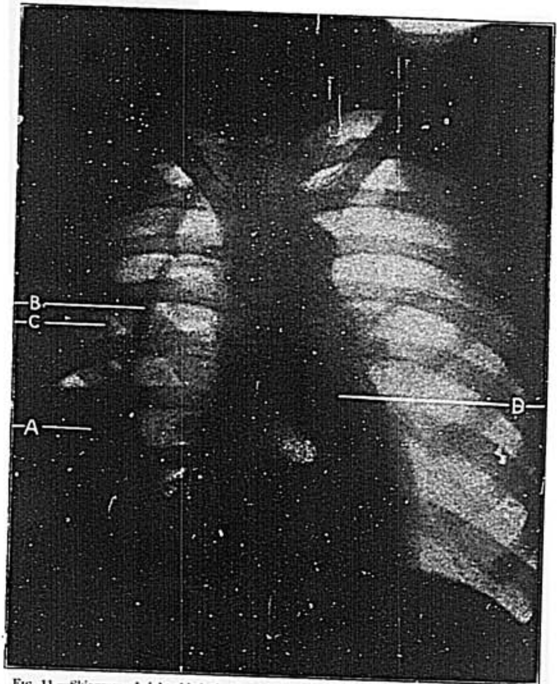

Fig. 11.—Skiagram of right-sided pleurisy with effusion; vertical position of fluid enveloping lateral aspect of lung, in which a portion of the exudate has been removed by aspiration: *A*, fluid shadow; *B*, posterior line of adhesions; *C*, anterior line of adhesions; *D*, heart and blood-vessels.

bined with the more or less vertical positions of the fluid explains the absence of Grocco's sign in all those pleurisies with the exception of the ones occupying the lower portion of the upright chest. The displacement of the heart when present is shown by fluoroscopy to be practically that of a displaced heart in its normal axis.

VISCERAL PLEURISY.

Interlobular pleurisy occurs most frequently between the upper and lower lobes of the right lung. This is due probably to the fact that the majority of cases are due to tuberculosis which has a predilection for the upper lobes. A tuberculous lesion of this lobe extending to the interlobular fissure causes a collection of fluid between the lobes which may or may not reach the thoracic wall. These exudates are very difficult to diagnosticate without the aid of an *x*-ray examination. On the other hand, the diagnosis is comparatively simple with this aid. In this series of cases there were 2 which gave identically the same skiagraph, as is shown in Fig. 12.

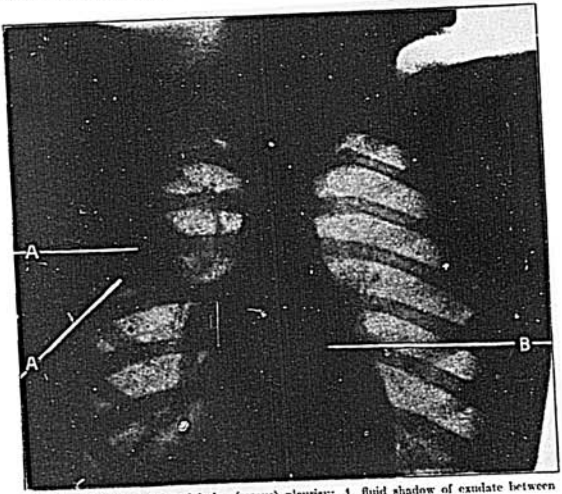

FIG. 12.—Skiagram of interlobular (serous) pleurisy: *A*, fluid shadow of exudate between upper and middle lobe of right lung; *B*, heart and vessel shadow.

In one of the cases the diagnosis of tuberculosis of the upper lobe was made; in the other, a positive diagnosis could not be made on account of the indefinite physical findings. Both cases showed by the skiagraphic and fluoroscopic examination a definite collection of fluid between the upper and middle lobes of the right lung, which was proved by puncture and other clinical evidence to be nonpurulent in character. In these cases paracentesis performed before the fluoroscopic screen is of value in directing the needle into the effusion.

Phrenic Pleurisy. The diagnosis of diaphragmatic and subphrenic collections of fluid has been greatly facilitated by the *x*-ray examination. In all subphrenic conditions, the majority of which are associated with the collection of an exudate below the diaphragm, the diaphragm is projected upward into the thoracic cavity beyond its normal limits. If this projection is extensive, the condition may be recognized by physical examination, but these findings are rarely sufficient upon which to advise radical treatment. On fluoroscopic examination the presence of an immobile diaphragm of normal contour and curve projected above its normal position in the thorax is pathognomic of a subphrenic collection of fluid. Diaphragmatic pleurisy, or a pleurisy between the lower lobe and diaphragm, should be suspected in those cases which produce a fluid shadow in the inferior portion of the chest, obliterating the normal curve and movement of the diaphragm, but not extending to the chest wall.

CONCLUSIONS. 1. The location of the fluid in serofibrinous pleurisy is variable. In a great majority of the cases it is more or less in the vertical position in the upright chest. The location is probably dependent upon the most constant position assumed by the patient during the acute stage of the disease. Adhesions forming at this time encapsulate the effusion, fixing it permanently in this portion of the chest.

2. The encapsulation of serofibrinous effusion in different positions of the pleura will explain the discrepancy of the physical findings with relation to the displacement of organs, Grocco's sign, obliteration of Traube's space, mobility with change of position of the chest, and other confusing physical findings.